

WHAT IS CLAIMED IS:

1. In a semiconductor device including: a substrate of a first conduction type with a low impurity concentration and a band gap of 2.0 eV or higher; a first region formed in a first plane of the substrate and having the same conduction type as and a lower resistance than the substrate; a first electrode formed in another plane of the first region; a second region formed in a second plane of the substrate and having the same conduction type as the substrate; and a second electrode formed in the second region; the semiconductor device comprising:

a trench formed in the second plane of the substrate;

a control region formed from a bottom of the trench into the substrate and having a different conduction type than that of the substrate;

a control electrode formed in the control region; and

the second electrode formed over the control electrode through an insulating film.

2. A semiconductor device according to claim 1, wherein the control region of a different conduction type than that of the substrate is formed in at least a part of a sidewall of the trench.

3. A semiconductor device according to claim 1, wherein the control region in the sidewall is formed in contact with the second region.

4. A semiconductor device according to claim 2, wherein a narrowest portion of a channel region located beneath the second region and between the control regions is deeper than one-half a depth of the control region.

5. A semiconductor device according to claim 2, wherein an insulating film is formed between the sidewall and the control region.

6. A semiconductor device according to claim 2, wherein a width of the control region is made narrower on the second region side than on the first region side.

7. A semiconductor device according to claim 2, wherein, of the channel region between the control regions, a sidewall portion adjoining the sidewall of the trench is made a MOS channel.

8. A semiconductor device according to claim 2, wherein the control region in contact with the sidewall of the trench is formed with a Schottky contact to provide a MESFET.

9. A semiconductor device according to claim 1, wherein the second electrode is formed over an entire surface of the unit device.

10. In a semiconductor device including: an n-type drift region with a low impurity concentration and a band gap of 2.0 eV or higher; an n-type drain region formed in a first plane of the drift region and having a lower resistance than the drift region; a drain

electrode formed in another plane of the drain region;  
an n-type source region formed in a second plane of the  
drift region; and a source electrode formed in the  
source region; the semiconductor device comprising:

    a trench formed in the second plane of the  
drift region;

    a p-type gate region formed from a bottom of  
the trench into the drift region;

    a gate electrode formed in the gate region;  
and

    the source electrode formed over the gate  
electrode through an insulating film.